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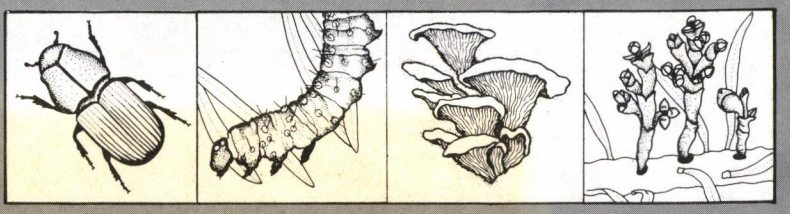

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NEEDLE TIP DIEBACK OF PONDEROSA PINE SEEDLINGS AT THE COEUR D'ALENE NURSERY, IDAHO

by

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ABSTRACT

Needle tip dieback of 2-0 ponderosa pine seedlings at the Coeur d'Alene Nursery was investigated. Organisms associated with dieback symptoms were identified and infected trees were transplanted to determine disease effects on survival. The major fungus colonizing necrotic needles was Lophodermium nitens, a close associate of L. pinastri. The fungus often sporulated on the necrotic distal portion of needles. Necrotic tips were often broken during lifting and handling of seedlings. Most infected trees produced a new flush of foliage after transplanting and probably recovered from the disease. Control of the disease is not warranted.

INTRODUCTION

Ponderosa pine (Pinus ponderosa Laws.) is one of the most important conifer crops produced at the Coeur d'Alene Nursery in Idaho. Many 2-0 pine seedlings lifted for shipment during the spring of 1982 displayed extensive needle tip necrosis (fig. 1). However, the bases of most affected needles remained green and premature needle abscission was uncommon. Necrotic needle tips often broke off during lifting and packing operations. Severely affected seedlings looked like their foliage had been chewed because of all the broken needle tips. Nursery personnel and those receiving the seedlings for outplanting were concerned about whether the disorder was serious enough to affect seedling survival. Therefore, investigations were conducted to help answer this question and to determine cause(s) of the disorder.

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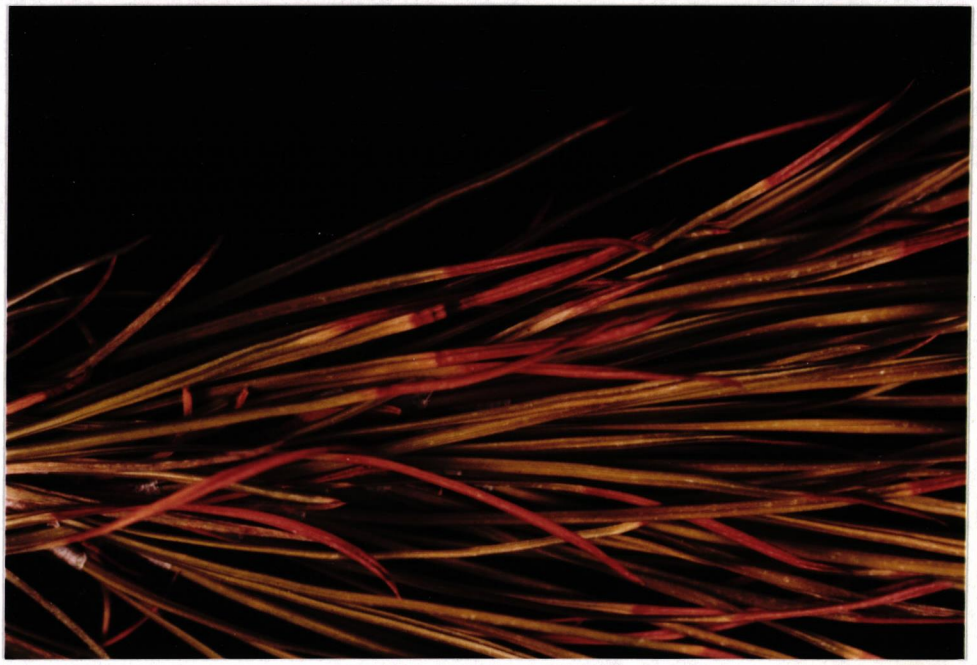

Figure 1.--Needle tip dieback of 2-0 ponderosa pine seedling produced at the Coeur d'Alene Nursery. Necrotic tips were usually colonized by Lophodermium nitens and several other secondary saprophytic fungi.

MATERIALS AND METHODS

Packaged seedlings with tip dieback symptoms were examined for presence of fungi. Several seedlings with necrotic tips were taken to the laboratory for dissection and microscopic examination. Isolations were made from necrotic and adjacent green tissues.

Fifty seedlings with slight to severe needle tip dieback were transplanted during late spring into 2-liter capacity plastic pots to evaluate survival. Planting medium consisted of sandy loam soil covered with a 10-ml layer of peat moss. Each seedling was fertilized with a nitrogen-phosphorus-potassium combination fertilizer at recommended label concentrations shortly after transplanting. Seedlings were kept outside and watered as needed to maintain moist soil throughout the growing season. After tree dormancy in the fall, seedlings were examined for general health and vigor, amounts of needle necrosis, and mortality.

RESULTS

Microscopic examination of needles with tip necrosis revealed many fruiting bodies of a hypodermataceous fungus classified as Lophodermium nitens Darker (Darker 1932; Darker 1967). 1/ Several needles with green

1/ Classification of this fungus as L. nitens was confirmed by T. H. Nicholls (USDA Forest Service, North Central Forest Experiment Station).

bases had these fruiting bodies on their distal, necrotic portion. Fruiting bodies were generally of two types. The largest were elliptical, shiny black in color, and located on the outer surfaces of needles. When moistened, these ascocarps (hysterothecia) opened by a narrow, sharply defined fissure in the middle. Ascocarps measured 650-800 μ in length and 370-450 μ in width. Thin sections revealed that ascocarps were approximately 200 μ in depth, subcuticular, but located on the outside of host epidermal tissues (fig. 2). Within ascocarps, asci intermingled with slightly longer hooked paraphyses made up the hymenial layer (fig. 3). Asci were cylindrical to clavate, contained eight ascospores, and measured 100-110 μ x 11-15 μ. Ascospores were filiform and fasicular.

Other fruiting bodies common on necrotic needle tissue were subcircular, black erumpent pycnidia. These structures measured 350-400 μ x 50-75 μ and contained cylindrical, hyaline, 1-celled conidia measuring 1-1.5 μ x 7-9 μ. Pycnidia were more numerous than and interspersed with the larger ascocarps.

Several other fungi were commonly isolated from necrotic needles. These include members of the genera Phoma, Alternaria, Penicillium, and Epicoccum. These fungi also sporulated on necrotic needle tissues incubated in moist chambers.

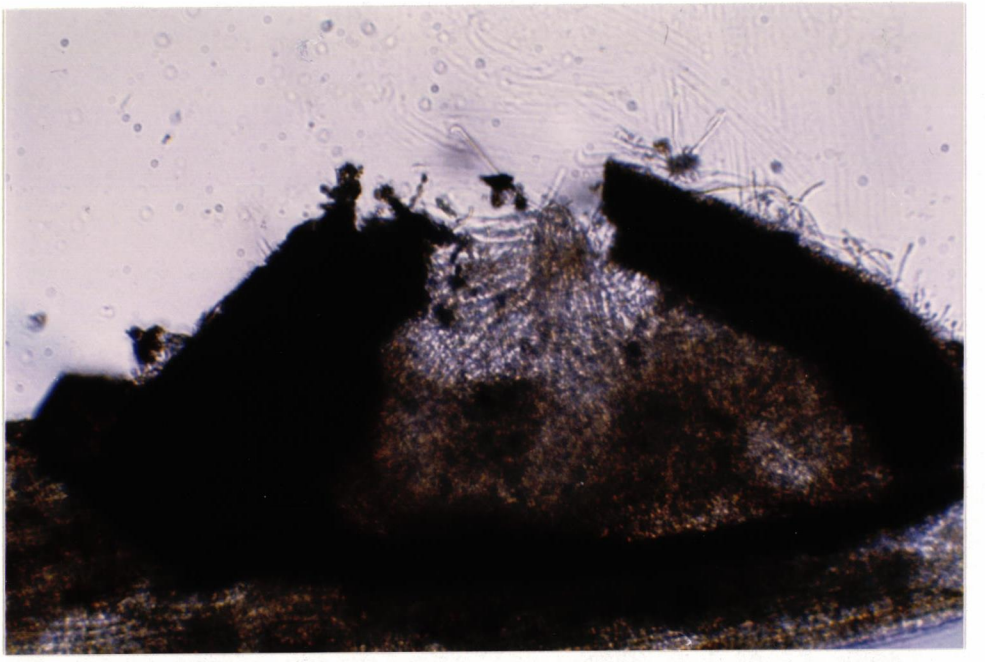

Figure 2.--Photomicrograph of cross section of an ascocarp of Lophodermium nitens (x100). Ascocarps are subcuticular but outside the host epidermis and open along a nonlipped fissure when moistened.

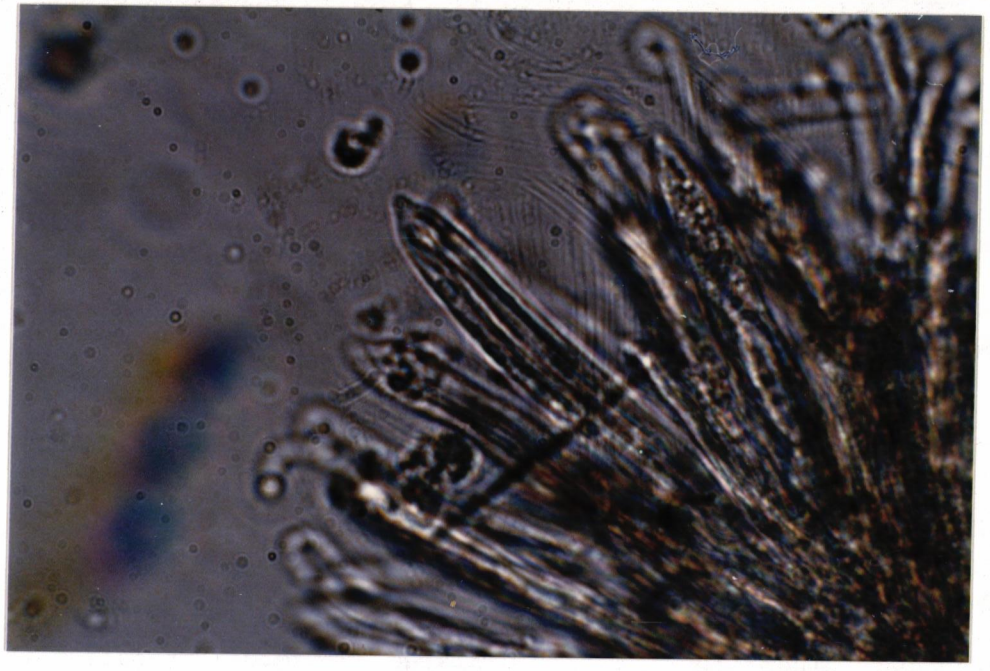

Figure 3.--Photomicrograph of asci intermingled with slightly longer hooked paraphyses (x450). Asci are clavate to cylindrical and contain eight filiform ascospores which are forcibly released, windborne, and cause needle infection.

Fungal infection of needle tips did not affect first season survival of transplanted seedlings (table 1). Although several seedlings died, they were not killed by needle fungi. Rather, their roots were dead and were probably injured or desiccated prior to transplanting.

Problems with root mortality and poor root-shoot ratios were common on certain lots of ponderosa pine seedlings lifted during the spring of 1982 at the Coeur d'Alene Nursery. Outplanting failure of pine because of damaged root systems occurred sporadically throughout the Region. Lodgepole pine was similarly affected. The problem was primarily excessive root pruning during lifting and drying of roots during storage due to stock dormancy problems. Therefore, seedling mortality obtained in this test was likely due to root problems.

Needle necrosis did not increase on the transplanted seedlings. Most (about 95 percent) of the infected seedlings produced a new flush of needle growth during the summer following transplanting (table 1). By the end of the growing season, infection of these new needles was not apparent.

Table 1.--Survival and tip dieback of transplanted ponderosa pine seedlings from the Coeur d'Alene Nursery.

Seedlings transplanted	Survival after first growing season	Percent needles with dieback symptoms			Symptom recovery 1/	
					Recovered	Nonrecovered
		80-100	50-80	0-50		
No. 50	39	15	21	3	37	2
% 100	78	3.85	53.9	7.6	94.9	5.1

1/ A measure of production of new nonsymptomatic needles. Recovered seedlings produced this new flush of foliage with no noticeable new infection; nonrecovered seedlings did not produce the new flush.

DISCUSSION

The fungus commonly associated with tip dieback of ponderosa pine seedlings at the Coeur d'Alene Nursery was characteristic of the genus Lophodermium because of its black, elliptical ascocarps, narrowly clavate or cylindrical asci, and continuous filiform ascospores (Darker 1967). Classification to a particular species within this genus is difficult because of the normally continuous range of morphological characteristics of related fungi (Tehon 1935). Several characteristics including hymenial, ascospore, and pycnidial morphology were similar to those described for L. pinastri (Darker 1932).

Lophodermium pinastri is often considered as an aggregative group of distinct organisms (Miller and Watson 1971). There are numerous strains, races, and varieties of the fungus, each differing in their capacity to cause disease (Ziller and Hunt 1977). Characteristics often used to distinguish L. pinastri from other species include partly subepidermal ascocarps with red fissure lips and thin black transverse lines across infected needles (Minter et al. 1978; Morgan-Jones and Hulton 1979). However, there were several notable differences between these characteristics and those of the fungus infecting ponderosa pine needles at the nursery. Ascocarps were subcuticular and entirely on the outside of the host epidermis; ascocarp fissures also lacked distinctive lips. These differences would place the fungus as L. nitens (Darker 1932; Morgan-Jones and Hulton 1977). However, these distinctions may not be taxonomically significant. For example, L. nitens is sometimes considered only a strain of L. pinastri and not a distinctive species (Lanier 1967). Pathogenic performance on different hosts is probably the key to taxonomic differentation in this group (Tehon 1935). Lophodermium nitens is more common on 5-needle pines (Darker 1932; Ziller and Hunt 1977), whereas L. pinastri is usually found on red (Pinus resinosa Ait.), Scots (P. sylvestes L.) and associated 2-3-needle pines (Darker 1932; Nicholls and Skilling 1970).

Levels of aggressiveness and virulence of the Lophodermium infecting seedlings at the Coeur d'Alene Nursery are unknown. Since the fungus is closely related to L. pinastri, it may possess a potentially high level of pathogenicity. Lophodermium pinastri has caused extensive damage to pine seedlings in nurseries in the Lake States (Nicholls 1970; Nicholls and Skilling 1970) and Massachusetts (Spaulding 1935). The fungus also causes one of the most serious diseases of native pines in European nurseries (Collis 1972). Damage can be particularly severe if favorable weather conditions for infection occur or if trees are weakened or stressed (Weir 1913). In the United States and Canada, damage is greatest on exotic pine species, whereas native trees are often more resistant (Spaulding 1935; Ziller and Hunt 1977).

Although needle tip dieback of pine seedlings at the nursery was extensive, effects of the disease on first-season survival were minimal. Most infected seedlings produced a new flush of foliage. Fate of this new foliage cannot be evaluated now because symptoms do not become apparent until the spring following infection (Nicholls 1970). However, recovery from Lophodermium infection is common, although seedling vigor and growth may be reduced (Nicholls 1970; Nicholls and Skilling 1970). Because a native pine species is involved and little premature needle loss occurred, extensive mortality of outplanted ponderosa pine seedlings is not expected.

Native or planted pine trees near nurseries may serve as sources of Lophodermium infection (Nicholls 1970; Nicholls and Skilling 1970). Infected needles from nearby trees may carry inoculum to seedlings, thus initiating or maintaining a disease outbreak. Mature ponderosa pine adjacent to the Coeur d'Alene Nursery probably provided the initial inoculum for seedling infection.

Lophodermium needle disease can be effectively controlled in nurseries by application of fungicides (Nicholls 1970; Nicholls and Skilling 1970; Powell and Leben 1973; Ziller and Hunt 1977). Maneb (Dithane M-45®) is the most commonly used fungicide. In the Lake States, maneb is applied at least twice in the early spring and at 2-week intervals during late summer and fall (August 15-October 15) to protect foliage from infection (Nicholls 1970). Maneb only prevents needles from becoming infected and does not eradicate the fungus from already infected needles.

Control operations are not currently warranted at the Coeur d' Alene Nursery. If the disease becomes more noticeable with extensive premature needle casting, control may become necessary. To reduce infection hazard, ponderosa pine seedbeds should be located as far away from nearby mature pine trees as possible.

ACKNOWLEDGEMENTS

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